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*PRESS BULLETIN 141* *February 5, 1910*

# Florida Agricultural Experiment Station

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## STEM-END ROT OF CITRUS FRUITS—II, III, IV

**By H. S. Fawcett**

In November, a serious rot of citrus fruits was described in Press Bulletin 131, under the name of "Stem-End Rot." By "stem end" is meant the place where the stem joins the fruit. Since that time investigations have been carried on to learn the nature of the rot, in order that in the future the disease may be successfully combated.

The fruit first begins to soften and sink a little round the stem end, without the rind changing color. There is no blackening nor molding at first, and the rind remains intact over the softened interior. The rot proceeds inward along the fibers of the rag, and then outward into the pulp cells. At first both the inside and outside of the fruit remain almost unchanged in color; but, as the softening goes on, the rind turns dull brown. Finally the rag and the pulp cells are disintegrated, and the entire fruit becomes soft and mushy. Early in the development of the rot, small white specks are seen in the pulp. These are similar to those produced by freezing, or by the blue mold.

This rot usually occurs on full-sized fruits after they have colored. Though the softening may begin while the fruit is still hanging on the tree, it usually develops after the fruit has dropped or after it has been picked. In groves where the disease was most prevalent it was estimated that from 10 to 50 per cent. of the fruit had dropped. Some of this dropping was due to withertip or other causes, but in many cases a large percentage of the dropped fruit developed stem-end rot while lying on the ground. In one instance 30 per cent. of the grapefruit were estimated to have dropped from this cause. In other places the percentage was smaller, there being only from 1 to 5 per cent. of the fruit affected.

But the dropping and rotting of the fruit in the grove is not the end of the trouble. The rot may develop on fruit that to all appearances was perfectly sound when packed, and make itself apparent on arrival at the market. Reports have been received of shipments of oranges having from one to eighteen per cent. of the fruit affected by stem-end rot on arrival at New York.

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## Cause

The direct cause of the stem-end rot has been shown by laboratory experiments to be the growth of a species of fungus which appears to belong to the genus known as Achlya. It is closely related to the water-molds, and resembles in many respects the fungus causing the brown rot of lemons in California. Our experiments indicate that this fungus infects the orange only at the stem end. This was shown by placing pure cultures of this fungus upon the stem ends of sound oranges. In almost every case the oranges so treated developed the rot in two or three weeks, while in the laboratory at about 65 degrees F. When cultures were placed on parts of the oranges other than the stem ends, no infection resulted, except when a cut or abrasion had been previously made.

## How the Disease Spreads

1. That oranges already affected with the rot may spread the disease to sound fruits has been shown by placing pieces of rotted fruits upon the stem ends of sound oranges. The oranges so treated developed the rot in the same manner as did those on which only the fungus had been placed. Pieces of diseased oranges placed on parts of sound fruit other than the stem ends caused no infection.

2. That the soil may be the means of infection was shown by placing sound oranges, and a small portion of soil from under a severely infected orange tree, together in water for 24 hours. They were then wrapped in paper, and placed in a temperature of 85 degrees F. In one week 42 per cent. of these fruits showed an infection with stem-end rot.

## Suggestions

The following suggestions as to remedial measures are based on our study and experiments to date: (1) All dropped fruits should be picked up and destroyed, as they are liable to infect the soil and other fruits. (2) All fruits on the trees showing softening at the stem end should be removed and destroyed, as these too are liable to infect others. (3) As an additional preventive the fruit on the trees should be sprayed with ammoniacal solution of copper carbonate. The formula for this solution is; 5 ounces copper carbonate, and 3 pints of ammonia (26 degrees), to 50 gallons of water. Mix the copper carbonate with enough water to make a paste, pour in the ammonia, and dilute to the proper strength. Do not dissolve the copper carbonate before you need it, as the solution will deteriorate on standing.

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*PRESS BULLETIN 154* *September 13, 1910*

**UNIVERSITY OF FLORIDA**

**AGRICULTURA EXPERIMENT STATION**

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## STEM-END ROT OF CITRUS FRUITS—III

**By H. S. Fawcett**

This is the time of year when a recurrence of this trouble may be looked for in groves which have been previously affected by this disease. A small amount of dropping and decay of green fruit has already been noticed in one locality where the stem-end rot was prevalent last year. Microscopical examinations show that the same fungus is present there which was proven to be the cause of the injury last year.

### Description

The presence of the disease is indicated at this time of year by premature dropping of the fruit, and by a softening at the stem end, which takes place from a few days to three weeks after the fruit has fallen. Only in rare cases does the softening at the stem end occur before the fruit drops. Dropping of fruit may, however, take place from other causes, such as withertip, or lack of moisture. Decay of fruit may also occur without the presence of the stem-end rot. But dropping of fruit together with a large percentage of softening and decay at the stem end, are signs of the presence of stem-end rot. Sometimes a premature coloring at the stem end is an indication that this part of the fruit will in time soften and decay. On unripe fruit, the decay progresses rather slowly, advancing inward most rapidly along the central core and the inner white part of the peel, and lastly breaking down the juice sacs. The diseased portion of unripe fruit becomes brownish or coffee-colored. In ripe fruit the discoloration lags behind the softening.

### Suggestions As to Treatment

Spraying experiments conducted by the Experiment Station last year for the control of this disease were started late in the season. The results, however, indicate that either ammoniacal solution of copper carbonate or Bordeaux mixture may be used with advantage in checking the disease. (These sprays, however, cannot be employed without serious injury to the whitefly fungi when they are present in a grove.) Since the disease is infectious, all dropped and decayed fruit should be taken from the grove and destroyed.

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### Cause

The direct cause of this decay has been shown to be the growth of a species of fungus in the tissues of the orange. This fungus parasite is of microscopic size, and usually enters the fruit at the stem end. Experiments have shown that oranges begin to show decay in from one to three weeks after artificial infection with the fungus.

### Investigations

Studies of this disease and of the fungus causing it have, so far, brought out the following facts:

1. Sound citrus fruits were infected by placing on them pieces of diseased fruit.
2. Sound fruits were infected by placing on them pure cultures of the fungus isolated from decayed fruit.
3. Sound fruits were infected by placing them in water for a few hours along with soil from under infected trees.
4. Cultures of the fungus were obtained from the soil, as well as from the diseased fruit.
5. The fungus lived for three months in air-dried soil in the laboratory.
6. The fungus grew well in either acid or alkaline media.

### Information and Specimens Wanted

As the writer wishes to find out as much as possible about this disease, he will appreciate it if the growers will send in specimens of infected fruit with information as to the severity of the disease. Any one sending specimens will be privately informed as to the presence or absence of the disease. Send to "Plant Pathologist, Florida Experiment Station, Gainesville, Florida."

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UNIVERSITY OF FLORIDA

AGRICULTURAL EXPERIMENT STATION

# STEM-END ROT OF CITRUS FRUITS—IV

By H. S. Fawcett

## Treatment

Both Bordeaux mixture, in the usual strength of 5 pounds of rock lime and 5 pounds of copper sulphate to 50 gallons of water, and ammoniacal solution of copper carbonate in the proportion of 3 ounces of copper carbonate and 5 pints of ammonia (26 degrees) to 50 gallons of water, have proved effective in checking this disease. Spraying should be done with the aim of hitting the fruit, keeping the spray as much as is practicable from the leaves, branches, and trunk, where beneficial fungi may be present.

## Spraying Experiments

Although the complete results of experiments now being carried on in six different groves by the Experiment Station, or under its direction, will not be at hand until the end of the picking season, the following beneficial effects have already been noticed from the use of either Bordeaux mixture or ammoniacal solution of copper carbonate.

The fruit on one lot of badly diseased grapefruit trees was sprayed three times with Bordeaux mixture, on September 5, 12, and 29. A similar lot of diseased trees, next to these, was left unsprayed until September 29, when it was also sprayed. On October 11, at which time it was too soon for much of a result from the last spraying to appear, it was found, by counting, that four times as many fruit had dropped from those trees which had been sprayed only once, as from the same number of trees which had been sprayed three times.

In a second experiment in the same grove, ten orange trees were sprayed with Bordeaux mixture on September 12 and 29, and ten similar trees next to them were left unsprayed. On October 11 there were counted nearly twice as many dropped fruit under the ten unsprayed trees as under the ten sprayed trees. Later counts are expected to show still greater effects from the spraying.

Last year every alternate tree of a block of forty grapefruit trees was sprayed twice with ammoniacal solution of copper carbonate, on December 4, and on December 14. On December 21 there were one-third more dropped

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ruit (counted), picked up from under the unsprayed trees than from the prayed trees. Considering the lateness of the time, this was a rather good howing in favor of the spraying.

These experiments show that both the sprays are useful in checking this isease. The sprays are most effective when used early, while the fruit is till green; but they will do much good even when used at this late season. Among other experiments which are being conducted, is a test with a com-ined fungicide and insecticide, to find out whether it can be substituted for he Bordeaux mixture or the ammoniacal solution of copper carbonate. It is esirable that such a substitute should be found, because of the damage done y these two sprays in allowing an increase of scale insects.

### Observations in Citrus Groves.

As the season advances there is an increased amount of Stem-end Rot howing in some localities, while in others there appears to be less than ast year. Previous to the storm of October 18, in some groves as many as to 10 per cent. of the grapefruit and oranges had already dropped from his disease.

Stem-end Rot is present and destructive on all characters of soil, and in roves fertilized in all sorts of ways, providing the fungus causing it is present. t is, however, noticeably worse in low damp groves than in higher and drier and. Although laboratory experiments show that the fungus may penetrate he skin of healthy fruit, observations in the grove indicate that those fruits which are weakened near the stem by any cause, such as scale insects, are nost likely to be attacked. Even in the grove, however, perfectly sound fruit nay also be attacked.

### Symptoms of Stem-End Rot

The presence of this disease is indicated by the dropping of the fruit, ollowed by a softening at the stem end, which softening takes place within few days to three weeks after the fruit has fallen. Only in rare cases loes the softening at the stem end occur before the fruit drops. Dropping f the fruit may, however, take place from other causes, such as withertip, horn punctures, etc. Decay of fruit may also occur without the presence f stem-end rot. But dropping of fruit together with a large percentage of softening and decay at the stem end, are signs of the presence of Stem-end Rot. Sometimes a premature coloring at the stem end is an indication that his part of the fruit will in time soften and decay. On unripe fruit the decay progresses rather slowly, advancing inward most rapidly along the central core and the inner white part of the peel, and finally breaking down he juice sacs. The diseased portion of the fruit becomes brownish or coffee-colored. In ripe fruit the discoloration lags behind the softening.

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